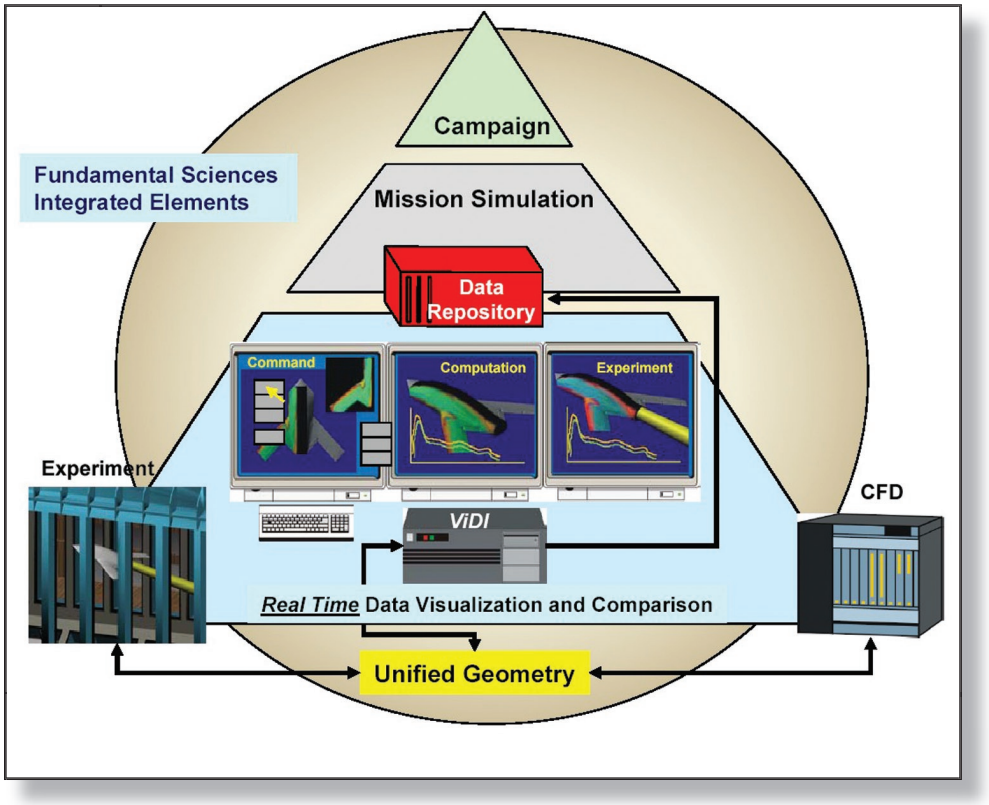
Air Force Research Laboratory|AFRL

Science and Technology for Tomorrow's Air and Space Force

Success Story

LINKING COMPUTATIONAL AND EXPERIMENTAL METHODS



A collaborative effort in rapid technology assessment between the Air Vehicles Directorate, Innovative Scientific Solutions, Inc., and the National Aeronautics and Space Administration Langley Research Center successfully demonstrated the ability to provide a near real-time comparative evaluation of experimental and computational simulations. The process eliminated the significant time lag between numerical analysis and the acquisition of experimental test data to validate the analysis, which impedes aerospace technology breakthroughs.

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Accomplishment

The directorate initiated a joint Computational Fluid Dynamic/ Experimental Fluid Dynamic (CFD/EFD) test program to investigate and analyze the aerodynamic flow field of the X-45A Unmanned Combat Air Vehicle at the Subsonic Aerodynamic Research Laboratory. The testing involved a multitude of cross-functional specialties ranging from experimental global measurement techniques and computational fluid dynamics to state-of-the-art material manufacturing technologies.

Researchers strategically employed rapid technology assessment tools, such as pressure sensitive paint, projection moire interferometry, doppler global velocimetry, and virtual diagnostics interface to take real-time measurements. In turn, these measurements were compared to computational results in near real time and used to alter the test matrix, better understand the flow physics, and improve the fidelity of the numerical code simulation.

Background

Advanced technology assessment strategies that exploit simulation-based research and development rely heavily on the accuracy and fidelity of numerically based predictive methods. Ensuring reliable technology assessment requires validating computational methods with experimental measurements. These measurements are made using a model fabricated to contain multiple components such as pressure ports and cavities to house measurement and telemetry hardware, electronic systems, and tubing. This fabrication is time consuming and costly. Furthermore, in conventional EFD, individual measurement systems are deployed sequentially, which significantly increases the time and cost associated with acquiring the necessary information. Without simultaneously deployed global diagnostics, understanding and modeling aerodynamic cause-and-effect relationships are difficult.

Ideally, measurement techniques would be deployed simultaneously to minimize wind tunnel occupancy with comprehensive parallel data reduction in near-real time. This process would provide a mechanism to confirm spurious results, identify the source of unpredicted behavior, and provide online comparisons of CFD/EFD data sets. Rapid technology assessment is making this ideal a reality.

Air Vehicles
Emerging Technologies

Additional information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (03-VA-09)